Terms of reference (ToRs) for the procurement of services below the EU threshold

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Preparation of a study on

Potential for Demand Side Management in Industry

Project number/ cost centre:

18.9022.7-003.00

0. List of abbreviations

AVB	General Terms and Conditions of Contract (AVB) for supplying services and work 2018
ToRs	Terms of reference

1. Context

To enhance and deepen the strategic political dialogue about the ongoing energy transition in both countries, the German Chancellor and the Indian Prime Minister established the **Indo-German Energy Forum (IGEF)** in April 2006. Strategic cooperation projects between the German and the Indian government, research institutions and the private sector are the major objectives of the IGEF.

The focus areas of this high-level bilateral forum are energy efficiency, renewable energy, and energy security, investment in energy projects as well as collaborative research and development, taking into account environmental and social challenges of a sustainable development.

Four subgroups were formed to put the above aim of the IGEF into practice. Subgroup III focuses on topics related to energy efficiency. The following priority issues have been identified:

- Energy Efficiency in Buildings
- Cooling
- Energy Efficiency in Industry
- Demand Side Management / Demand Shift
- Public electric vehicle Charging Infrastructure

DESCRIPTION OF THE ASSIGNMENT

The aim of the assignment is to evaluate the applicability of dynamic pricing tariffs by identifying potential industries which could adapt their production processes (as well as large commercial consumers) to the variable energy supply increasingly generated by renewable energy sources such as sun or wind. Such dynamic tariffs could help to develop a new dynamic equilibrium to balance supply and demand, with sufficient flexibility in demand (see Arnold and Janssen, 2018). To evaluate the potential of dynamic tariffs, the examples of global best practices of the implementation of dynamic tariffs as well as requirements for implementation have to be demonstrated. Furthermore, the current status of static tariffs with diverse price settings such as Time of Day (TOD) or Time of Use (TOU) respectively has to be analyzed, in order to identify industries which can adopt their energy demand to different fluctuating energy prices.
Moreover, the situation and potential of dynamic pricing tariffs such as Real Time Pricing (RTP) in India should be analyzed. The study shall show worldwide RTP pricing mechanisms which lead to the increased usage of RE in place of captive coal-fired power plants or oil respectively. Hereby, the benefits for the grid company, electricity users, renewable power generators and the environment should be analyzed. Currently some RTP pricing tariffs focus on adjusting the difference between the peak load and the off-peak load for the whole grid and easing the shortage of power. In contrast, dynamic tariffs based on the electricity generated from the variable renewables shall consider the supply of the electricity. There are several intervals in a day when there is surplus generation on the grid and dynamic prices can incentivize to store this surplus rather than curtailing such generation, as practiced presently.

The variability and randomness of renewables is a big challenge for the Indian grid, as it is operated far from its potential optimum and the variable supply of electricity by RE stresses the grid even more. A better balancing of variable RE in the grid would facilitate an increased usage of RE. The Indian peak demand (today and in the near future) usually occurs during afternoon and the evening time. While it is obvious that Solar/PV is beyond its peak during the evening time, wind-power is often down in the evening hours as well. Furthermore, wind-power has a strong seasonality. To sum it up, there is an enormous variation in power from RE.

This leads to the question of how the energy consumption can be adapted to electricity generation from the variable renewable energies. Therefore, a potential dynamic RTP tariff could help to lower the peak time demand, as it could incentivize the energy usage during off-peak demand or peak supply of RE energy respectively. Another way to achieve Industrial and Commercial Demand Response is a legal provision regarding the loads that can be switched off by the grid operator which also regulates the accompanying compensation. In Germany, for instance, such agreements are voluntary and are open to all large customers. Steel industry, aluminium industry, car manufacturers and pharmaceutical firms participate along with refineries. It is expected that around 40% of the overall costs for steel in a very modern plant come from electricity.

Furthermore, increasingly storage technologies benefit from RTP tariffs. Main options applied are thermal storage, pumped storage, battery technologies (e.g. electric cars can be used as storage solutions as they are being charged during off-peak hours which then give electricity back to the grid in high demand times, also called Vehicle to Grid (V2G)) and hydrogen electrolysis.

The study shall explore the potential of demand shift in India. Therefore, the main energy intensive industries and large commercial consumers, which might be interested in economic benefits from demand shift (e.g. energy intensive industry, large cooling houses, malls, etc.), have to be identified. How high is technical ramping capacity? To which extend would it make sense for the consumer to ramp down or up on demand? For how long? At which notice time in advance? Which incentives would be required?

A mixed approach of desk research and interviews with stakeholders is to be chosen.

The structure of the report shall be as follows:

1. Cover
2. Imprint
3. Proposal for Foreword
4. Presentation of 5 key findings
5. Executive Summary
6. Introduction with Reasoning for Demand Response
7. Flexibility Options for Power Sector
   7.1 Define Demand Side Management / Demand Shift
   - Define the following:
     - Demand Response
     - Other relevant terms
   - Explain concept of:
     - Peak Clipping (Reducing the maximum peak in demand)
     - Valley Filling (preventing extreme lows in energy demand)
     - Load shifting
   - Other?

   7.2 Different Measures to Achieve Demand Response
   7.3 Different Time-based Tariffs
   - Explain Concepts like:

  - Demand Market Participation (DMP)
  - Dynamic Pricing Mechanism

7.3.1 Static Time-based Pricing Tariffs

- Flat Tariff
- Seasonal Tariff
- Time of Day (TOD)
- Time of Use (TOU)

7.3.2. Dynamic Time-based Pricing Tariffs

- Define dynamic pricing mechanisms in general:
  - Setting flexible prices for products/services/… depending on actual market demands
    - Differences whether the price mechanisms are based on elasticity, supply, demand, …
  - Critical Peak Pricing
  - Day ahead pricing / spot market price (Consumers are notified of the rates on a day ahead or hour ahead basis)
- Define Real Time Pricing (RTP) tariff and show clearly the difference to static time-based tariffs

7.4 Current Legal Situation in India

8. Global Best Practices of Implementation of Real Time Pricing
   - Compare different RTP Programs
   - Compare different Business Models

8.1 Industry Sector
8.2 Commercial Sector
8.3 Special Role of Demand Response Providers

9. Implementation Status of TOD/TOU Tariffs in India

- Create table with all states and show if TOD exists or not

9.1 Industry Sector

  - GW connected to the grid (steel, cement, fertilizer else?)
  - Visualize for each sub-sector typical load curve
  - TOD/TOU tariffs exist? If yes, what are their characteristics?

9.2 Commercial Sector

  - GW connected to the grid (steel, cement, fertilizer else?)
  - Visualize for each sub-sector typical load curve

  - TOD/TOU tariffs exist? If yes, what are their characteristics?

9.3 Way forward for Implementation of TOD/TOU

10. Cost for Flexibility in Industry

- Determine numbers of how many GW could be shifted by a specific industry, how fast they can ramp up / ramp down their production processes and how much this ramping down costs for a specific time (rough estimations – is it MW numbers, small GW numbers or high GW numbers?)
- Determine how high incentives for industrial firms would have to be to ramp down their electricity demand for a specific time period.
- How high do the incentives have to be in the secondary and tertiary electricity market?

11. Evaluation of the Applicability of RTP Tariff for potential Consumers

- Overview of RTP Tariff Implementation in India by States
- Current Challenges in the Implementation of RTP Tariff in India

11.1 Industry Sector

- Could a demand market participation (DMP) program be introduced, based on IEX spot market prices or similar?

12.2 Commercial Sector

- Could a demand market participation (DMP) program be introduced, based on IEX spot market prices or similar?

13. Identification of Challenges in Implementation of RTP Tariff for identified Consumers
14. Conclusion and future recommendations
15. References
16. Appendix

The report has to be delivered in word format. Cover and imprint information will be provided by GIZ. Please provide a proposal for a foreword.

Presentation of 5 key findings of the study

Please briefly highlight the five most relevant key outcomes of the study with respect to the applicability of flexible industry and commercial demand and possible implementation of RTP tariffs and/or special premiums for demand reduction.

- Airports, agricultural pumps, cold storages, steel plants, aluminium producer, fertilizer industry, chemical industry, Petro chemistry, Cement, Paper, Textile, Pharmaceutical companies, other are able to reduce their combined demand of 100 GW within 15 minutes for minimum 15 minutes?
- 15 super ultra-critical coal fired power plants could be substituted today by demand shift of industry. This would save x crore of investment for India.
- 10 GW can be ramped down for 2 hours without substantial impact on ease of production at considerable overall cost for the transmission grid operator and DISCOMs?
- 100 largest electricity consumers in India are able to provide around 20 GW of demand reduction for minimum 30 min. during peak hour demand by demand shift only? All Indian industry able to lower electricity consumption by approx. 30 GW during peak hour demand? (Especially Aluminium and Steel are able to deliver frequency control and demand reduction of 15 GW in today's condition.)
- Other?

Executive Summary

Please summarize the study on about one page and show especially the key findings in more detail.

Introduction

In an Indian power system scenario in 2022 with 175 GW of RE capacity grid balancing becomes an increasingly important task. Demand Response measures have been identified as one of the most cost efficient and environmentally friendly alternatives to adopt the energy demand to the fluctuating power supply from solar and wind capacity and especially to avoid high cost intensive investments in peak demand catering required for very few hours during the year only.

- Please state what is the aim of the study (see "Description of the Assignment")
- Illustrate why is the topic relevant, especially in India
- Point out present and future balancing requirements (NREL study)

"In the Electricity market, marginal costs vary by the minute, but retail prices are (for the most part) time-invariant (a so-called flat tariff). Because of this, the market does not function efficiently, and substantial economic loss may result, both in the short run and the long run. The disparity between wholesale and retail prices leads to chronic over and under consumption at different times of the day, excess capital investment to prevent blackouts, and an increase in the opportunity for fringe producers to exploit market power." (Jessoe and Rapson, 2015, p. 397)

In times of an electricity market with a predictable demand and supply through different mainly fossil fuel powered base-load plants, flat electricity tariffs for consumers might have been appropriate. But in times of increasingly higher shares of electricity from fluctuating renewable energy sources, the need for flexibility to balance demand and supply requires new solutions.

To achieve flexibility of an electricity system, different measures can be undertaken. Each measure has its own advantages and disadvantages, depending on several factors. Some solutions, like battery storage, might be extremely useful, but in many cases Demand Side

Management through dynamic electricity tariffs or the flexibilization of coal-fired power plants might be economically more viable.

Flexibility Options for Power Sector

This Chapter is to put Demand Side Management into the context of different Flexibility Options for the Power Sector, to determine basic assumptions and to define underlying concepts.

Power system flexibility is defined by the extent to which a power system can adopt electricity generation and consumption to maintain system stability in a cost-effective manner.

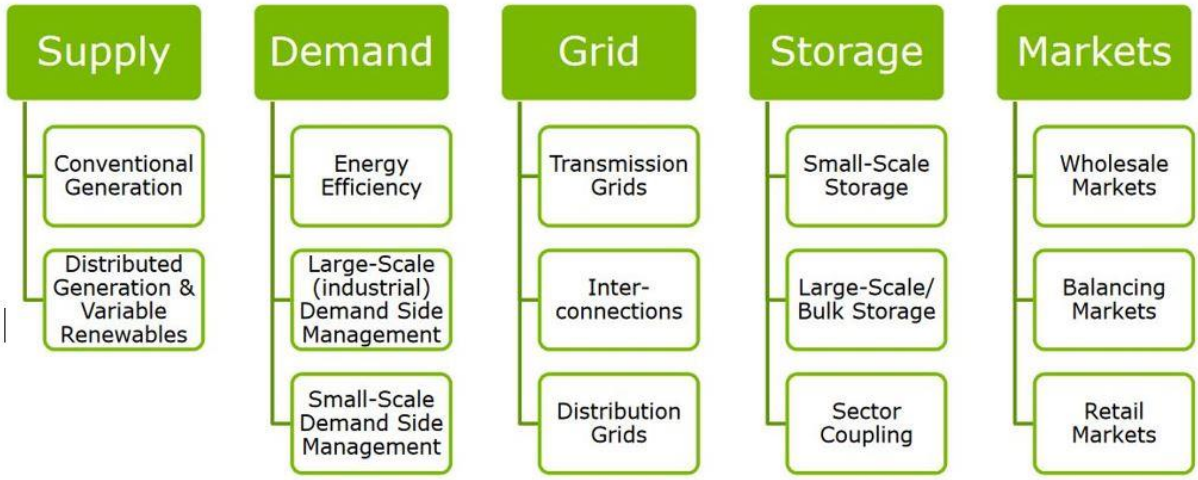
With increased shares of fluctuating power generation from variable Renewable Energy Sources, the flexibility of the power system becomes increasingly more important to guarantee grid stability without curtailing Renewable Energy Capacity. Furthermore, the rising costs for redispatch and curtailment costs might not be totally avoidable but should be kept as low as possible.

As per IEA each country faces at least four different phases of variable Renewable Energy Integration and its corresponding requirements for power system flexibility. Depending on the annual share of electricity generation by variable Renewable Energy sources IEA distinguishes between phase 1 with no relevant impact due to RE generation shares below 4%, and phase 2 with requirements of better operation schemes of the existing power systems for RE shares below 15% (see graphic below).

Phase X	Range of annual VRE generation share	Flexibility requirement
Phase 1	<5%	No relevant impact
Phase 2	5-15%	Better operations
Phase 3	15-25%	Flexibility is key
Phase 4	>25%	Short-term stability

Table: VRE deployment phase, IEA 2017

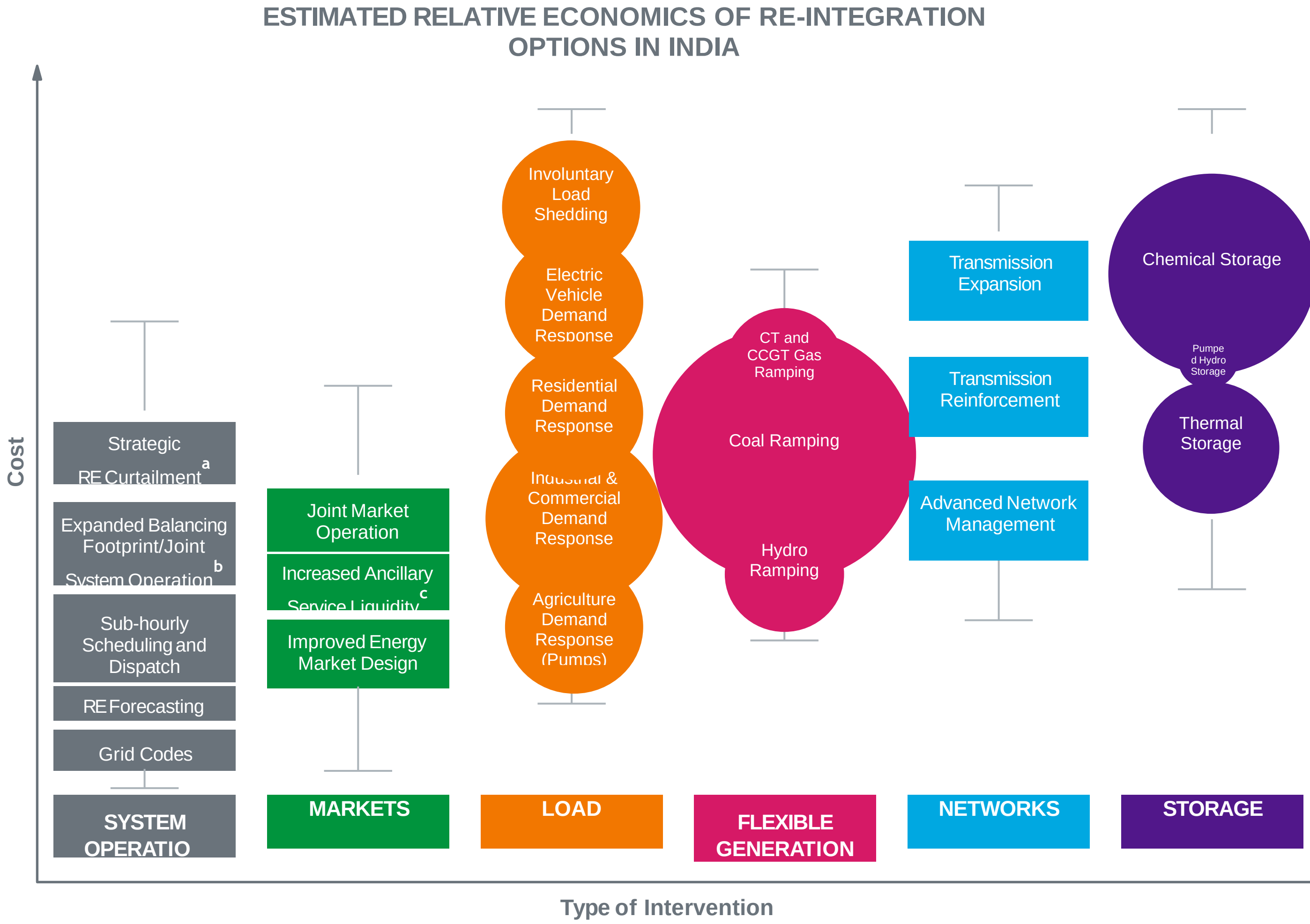
The phases vary from irrelevant variable RE Capacity for the Power System (Phase 1) to very high shares of variable RE Capacities above 25% with the requirement for bridging of seasonal deficit periods through involvement of seasonal storage and synthetic fuels as well as various short-term stability measures (Phase 4). As, per IEA, flexibility options become increasingly important for VRE shares above 5%. Power Flexibility Options can be divided into Supply Measures, Demand Measures, Grid Measures, Storage Related Measures and Market Interventions (see following graphic):



Source: Sach, T. (2016). Flexibility Trackers. Indicators for Power System Flexibility. Presentation at the Strommarkttreffen on 05/08/2016. Berlin

Market related flexibility interventions, such as dynamic pricing tariffs for electricity, certainly have their impact on the market development for all other flexibility options. In general, flexibility options related to market design, as well as measures related to the grid have been categorized as enablers for flexibility on the one hand and storage, supply and demand side interventions have been categorized as sources for flexibility on the other hand.

The following graphic shows different types of flexibility options differentiated by its presently estimated cost range.



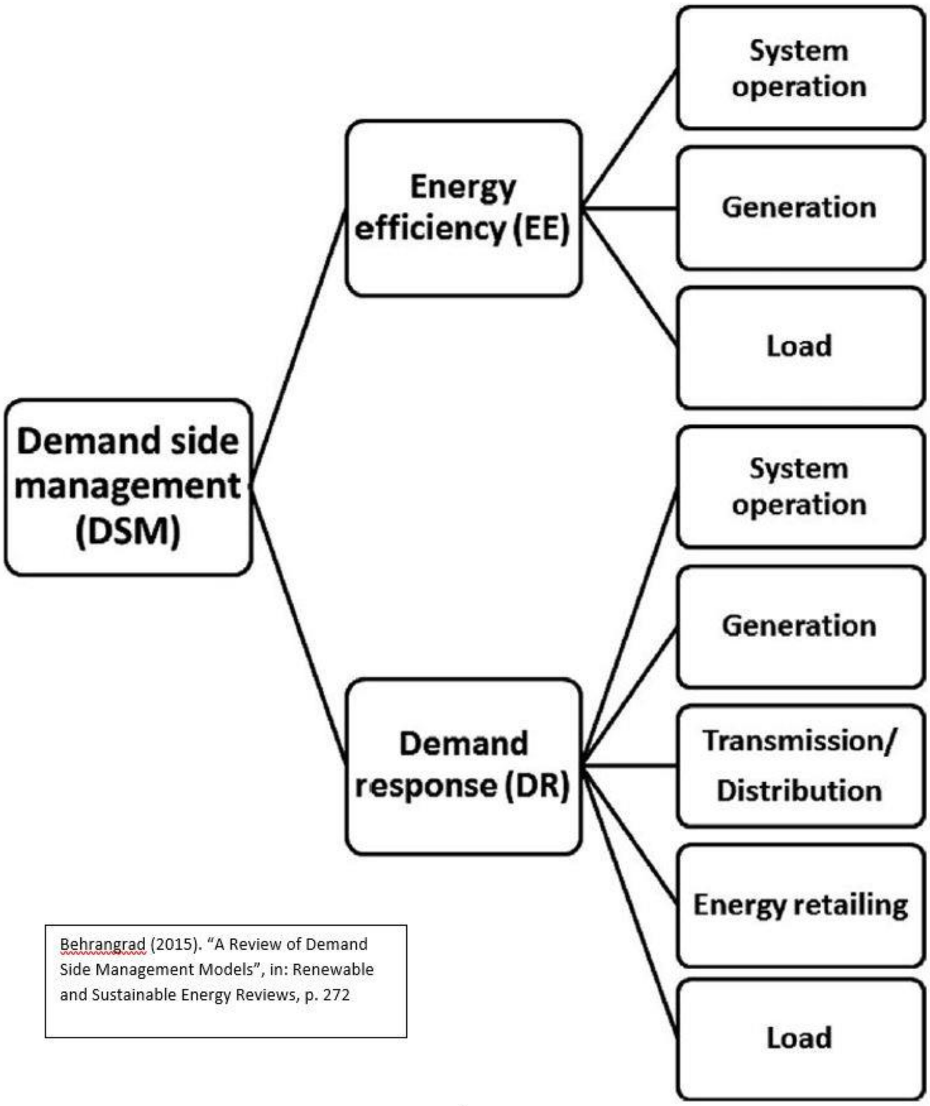
Industrial and commercial demand response is being perceived as a relatively cost-efficient flexibility option on the load side. Residential demand response gains a huge potential, but due to high essential investments, it is more expensive compared to industrial and commercial demand response.

As industrial and commercial demand response can be achieved by flexibilizing the demand through incentivizing higher electricity usage at certain times whilst decreasing electricity usage at other times, the applicability for the Indian energy market shall be determined.

- Elaborate a list of pros as well as a list of cons regarding the implantation of industrial and commercial DSM based on literature!
- Elaborate present and future flexibility requirements for the Indian power system based on existing literature (today, 2022 with 175 GW RE, and 2030).
- Show and explain Indian Duck Curve with peak load requirements for today, 2022 with 175 GW RE, and 2030
- Give short introduction to different options for flexibility as seen in the graphic above and brief status on implementation in India
- Other important terms, assumptions, etc.

Demand Side Management

Give definitions for Demand Side Management. Explain following graph (see PWC p. 4-7, see Behrangrad, M. (2015):



Behrangrad (2015). "A Review of Demand Side Management Models", in: Renewable and Sustainable Energy Reviews, p. 272

Define the following:

- Demand Response (DR)
- Energy Efficiency

Explain its impact on

- Peak Clipping (Reducing the maximum peak in demand)
- Valley Filling (preventing extreme lows in energy demand)
- Load Shifting

“Demand Side Management (DSM) is defined as every activity, including both direct and indirect measures, that leads to an adaption of the power demand to the conditions of power generation and the power grid.” (Arnold and Janssen, 2018, p. 3).

Demand Response (DR) is sometimes used as a subset of DSM, explaining how the consumer is pushed towards a specific behaviour. The MoP defines Demand Response as “ability to reduce demand from appliance to manage peak demand which would reduce the need for costly investments in energy supply, manage shortages, and improve the reliability of the electricity grid.” (MoP, 2016, p/ 3.12)

DSM usually includes three different strategies of load management which achieve short-term effects in the energy demand. These are Peak Clipping (reducing the maximum peak in demand), Valley Filling (preventing extreme lows in energy demand) and Load Shifting (ongoing shift of energy demand in order to balance the demand over time). (see Arnold and Janssen, 2018, p. 2-4).

Former Demand-side programmes for industry were primarily designed as a way to react to network congestions due to peak in electricity demand. However, one of the critical elements of the electricity system is how to properly integrate electricity generated from “variable”, or “non-programmable” renewable energy sources, like wind and solar, at a time of low or no demand. Therefore, the traditional demand-side programmes appear rather inadequate in coping with this challenge. (University of Cambridge)

Different Measures to achieve Demand Response

Aim of demand response is to achieve higher flexibility of demand

- Tariffs
- Regulation
- Subsidies
- Auctions

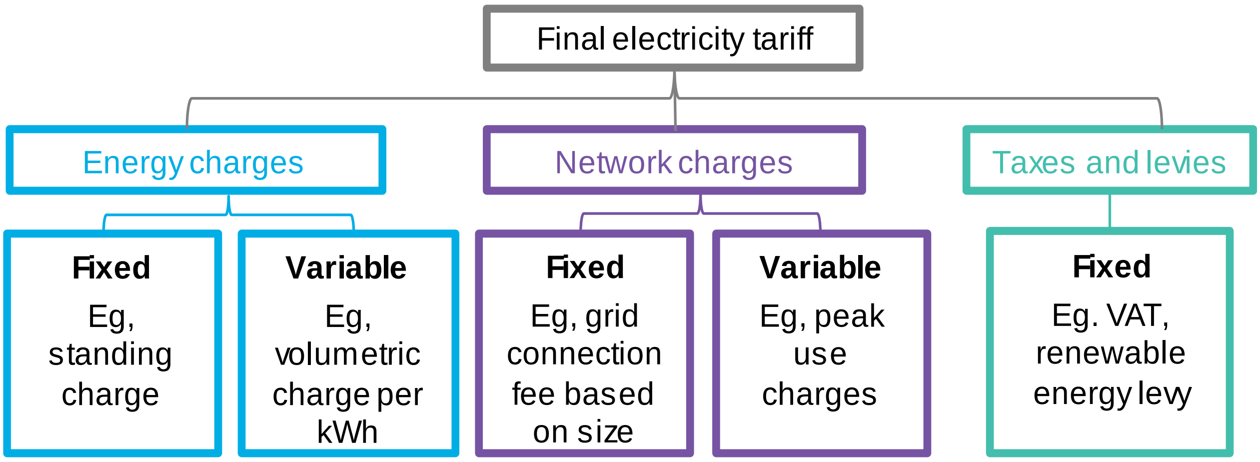
One of these measures is to implement time-based tariffs, which sets different prices for different times.

- **Different Time-based tariffs**

Explain further concepts like

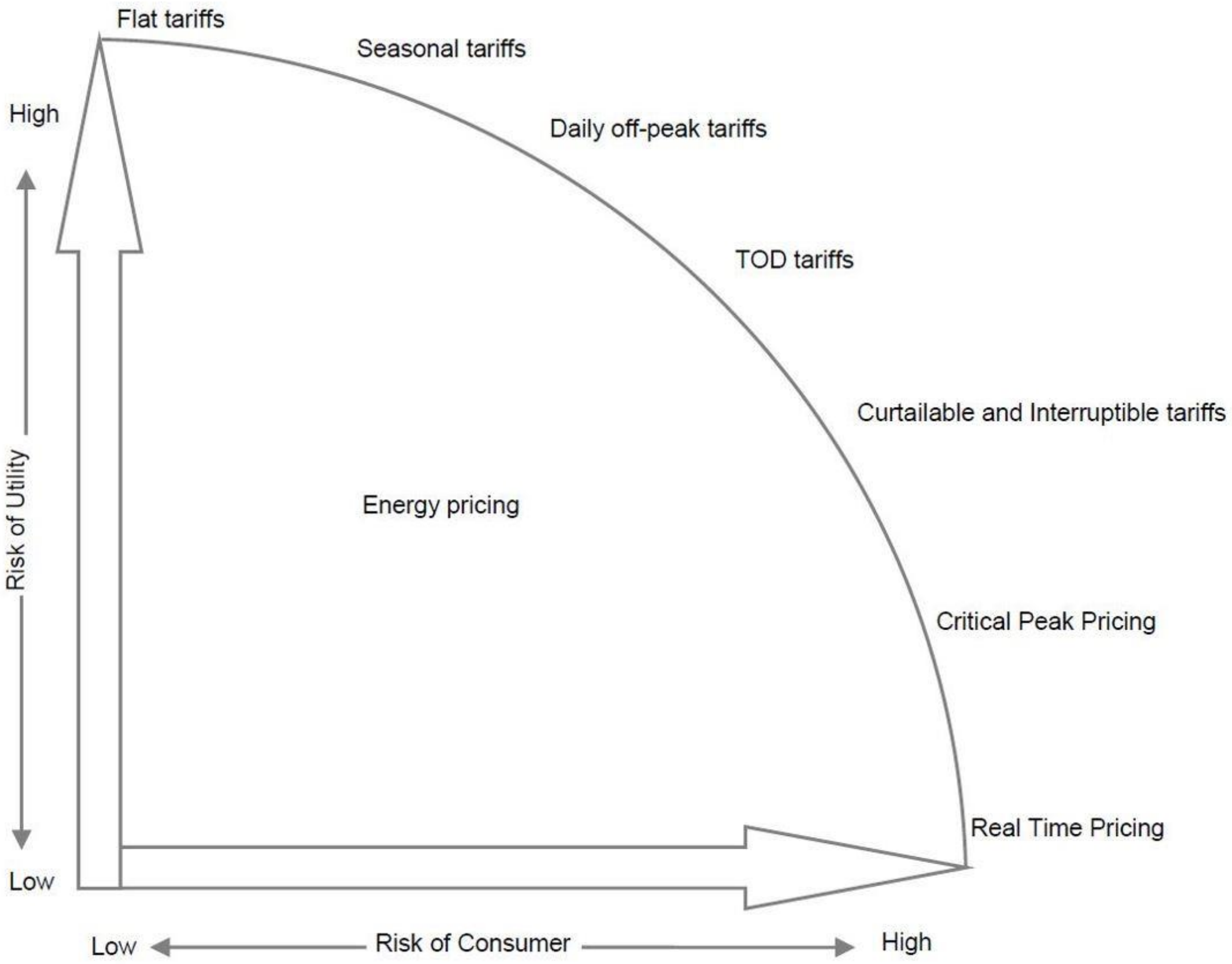
- Demand Market Participation (DMP)
- Dynamic pricing mechanism

Typical components of an electricity tariff



Source: BloombergNEF 2020

<u>Provide an overview of different time-based tariffs – see PWC p. 4-7</u>



PwC – "Assignment on Implementation & Impact Analysis of Time of Day (TOD) tariff in India" – p.5

Simplified overview of energy retail tariff types

Static pricing (fixed in advance)		Dynamic pricing (variable depending on market conditions)		
Flat-fee	**Time-of-use**	**Variable peak**	**Critical peak**	**Real-time***
Energy price is fixed constantly	Energy price is fixed for set periods over the day, usually in three blocks: peak, mid-peak, and off-peak. These can also vary from winter to summer	Same as time-of-use, but price of peak block can vary based on system conditions	Consumer is alerted or incentivized (eg, awarded credit) to reduce demand at or ahead of a specific time	Energy price reflects wholesale electricity prices all the time, or during certain intervals
	Flexible tariffs			

Source: BloombergNEF 2020

Further distinguish between static and dynamic tariffs.

- Static time-based pricing tariff

Give definitions and explain different static time-based tariffs, such as

- Flat tariff
- Seasonal tariff
- Time of Day tariff (TOD)
- Time of Use tariff (TOU)

- Dynamic time-based pricing tariff

Define dynamic pricing mechanisms in general

- Setting flexible prices for products/services/… depending on actual market demands
- Differences whether the price mechanisms are based on elasticity, supply, demand, …
- Critical Peak Pricing
- Day ahead pricing / sport market price (Consumers are notified of the rates on a day ahead or hour ahead basis)
- Define Real Time Pricing (RTP) tariff and show clearly the difference to static time-based tariffs

A Real Time Pricing (RTP) tariff is understood as a dynamic Time of Use (TOU) tariff. The RTP tariff depends on the current value of additional or avoided demand of electricity. Typical Real Time Pricing (RTP) tariffs for consumers vary on an hourly basis or even by a 15-minute basis.

- Define and explain the concept of primary, secondary and tertiary control of energy grids.

- Please show a graph, in which the different concepts are shown, with
- What are ancillary services?

In Europe large consumers are encouraged to adapt their demand by trading earlier purchased but not demanded electricity at the European electricity exchange. If market price is very high, these companies prefer to sell the power at the spot market as well as day ahead market and reduce their production process. If electricity prices go for example negative, they may increase their productivity.

- thyssenkrupp Steel Europe AG (Steel)
- VW Kraftwerk GmbH (Automotive)
- Trimet Aluminium SE (Aluminium)
- Deutsche Lufthansa Aktiengesellschaft (Airports)
- DB Energie GmbH (Railways)
- Hüttenwerke Krupp Mannesmann GmbH (Steel)

While the above German companies directly participate as members of the electricity exchange, most large industries have bilateral agreements indirectly participate through their DISCOM / retailer / electricity provider at the exchange. They increase or decrease the demand according to the financial compensation agreed.

Maximizing the volume of demand-side flexibility in the power system will be crucial to a successful sector coupling. Policy makers need to ensure the availability and uptake of flexible electricity tariffs, with strong incentives for all consumers to minimize net peak demand. As such, future tariffs will need to encourage users to shift consumption to times of renewables availability and to alleviate network constraints. Priority should also be given to the standardization and interoperability of the smart systems that are rolled out with sector coupling to provide the billing infrastructure for these tariffs.

Simplified overview of energy retail tariff types

Static pricing (fixed in advance)		**Dynamic pricing (variable depending on market conditions)**		
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	Flexible tariffs			

Source: BloombergNEF

The following inputs are word by word extracted from BNEF Report on Sector Coupling in Europe (https://data.bloomberglp.com/professional/sites/24/BNEF-Sector-Coupling-Report-Feb-2020.pdf) and shall give further guidance.

Flexible tariffs

The way in which the cost of electricity is passed on to the end-user is a key challenge for sector coupling. To drive initial uptake of electrification and then sustain the flexible use of electricity across different consumer types in the long term, tariffs will need to be designed to give the right signal to the end-user and accommodate the changing needs of the power system. Tariff innovation is well underway in markets with accommodating regulatory environments, but consensus on the optimal tariff design to unlock flexible demand has not yet been reached. There is also still significant uncertainty over the extent to which wholesale price exposure should be passed on to the end-user to incentivize demand response, especially as power markets become more complex and potentially more volatile with the growth of variable renewable generation. Electricity tariffs are split into three components, of which energy and network charges have both fixed and variable components. Here 'fixed' means the baseline fees that do not vary by kilowatt-hour usage. Variable, meanwhile, can be volumetric, where the rate is charged on a static kilowatt-hour basis, and time-varying volumetric, where the rate per kilowatt-hour is determined by the time of consumption.
It will be cheaper and result in lower emissions if new loads added through sector coupling are more responsive to price signals, where it is cost-effective to do so. The benefits of more responsive demand include reduced pressure on the supply side to balance variable wind and solar generation, and therefore less additional firm and peaking capacity needs to be built. As a result, it will be important for retailers and policy makers to promote consumers' uptake of flexible tariffs.

The EU internal electricity market directive legislated in 2019 mandates member states to ensure that all suppliers with a certain size of customer base offer a dynamic price contract,25 although not all EU countries have transposed this requirement into national legislation. Given the scale of demand-size flexibility required for a smooth sector coupling, governments should consider measures to promote flexible tariffs more strongly. For example, they could mandate retailers of all sizes to offer at least one dynamic tariff for each segment of consumers (residential, commercial and industrial). Any such mandate or policy should be designed carefully to ensure that retailers continue to have freedom to innovate and compete. Retailers in most liberalized European countries already offer many tariff options with time-of-use or variable-peak pricing, giving end-users some exposure to price risk in order to incentivize load shifting to cheaper hours of the day and reduce peak load. However, policy makers could also encourage suppliers to roll out more innovative tariff structures tailored to the needs of sector coupling. For instance, several utilities, including E.ON, OVO, Scottish Power, and SSE Energy, have flexible tariffs for EV drivers in the U.K. SSE offers a static time-of-use tariff for EV drivers to charge their car for free between 12pm and 7am, when power prices are generally lowest in today's rates. Flexible tariffs could help to minimize net peak demand and better integrate higher volumes of electrified building demand for heating, for example, by incentivizing thermal storage and load shifting as a source of demand-side flexibility. Tariff structures to unlock this would require more granular price signals, to encourage the

conversion of electricity to heat in hours outside of peak demand or when renewables are producing.
Successful sector coupling will need consumers to switch to flexible tariffs – but also stay on them as the need for demand-side flexibility ratchets up toward 2050. Flexible tariff offerings by retailers will therefore need to be agile, to sustain consumer engagement and future-proof the flexibility of demand – that is, retain demand-side flexibility over time even as 'optimal' times of use shift and evolve.

This agility will be particularly important in some coupled sectors, such as transport. By 2050, the cheapest hour of generation in the Northern and Southern European archetypes alike is expected to be delivered by solar output. To ensure that dynamic EV charging and other coupled sectors, like flexible electrified heat demand, can take advantage of these hours of generation, adequate planning will be needed on the location, distribution and accessibility of infrastructure, like public EV chargers. Regulators must therefore ensure that the price signal is sufficiently passed on to incentivize the optimal use of electricity, even as the relevant time to do so shifts.

Consumer engagement

It will not be enough that tariffs are available to spur demand-side flexibility; consumers need to sign up and then stay on them. Most consumers today have limited engagement, and take-up of flexible tariff offerings has been very low. These offerings are anyway still contingent on the availability of smart meters and appliances.
As such, policy makers should consider how to encourage uptake of dynamic tariffs over time as sector coupling proceeds, as well as improving price transparency and raising awareness. Sector coupling could create more opportunities to improve consumer engagement, particularly among households. Flexible tariff offerings for new demand sources, like EVs and heat pumps, might act as a sweetener to encourage consumers to become more active and engaged in their energy use as their electricity consumption ramps up. But given the myriad of electricity tariffs offered even by each retailer, policy makers could also take steps to improve consumers' understanding of pricing structures and the relative pros and cons. This could also offer opportunities for 'auto switchers' that offer the service of switching a consumer's tariff on their behalf.
Consumer engagement is generally better among large commercial and industrial end-users, but they may be more resistant to taking on additional wholesale price risk. For large companies, the energy component of a tariff is typically a flat-fee charge, often secured through a direct power purchase agreement (PPA). Dynamic tariffs can therefore offer a way to reduce these costs, but only if the end-user is willing to operate more flexibly.

Network charges for flexible coupling

Electricity grid operators recoup their costs for building, maintaining and operating infrastructure through regulated network charges. These charges are typically based on the size of a customer's connection or their peak demand during critical times of the year.
Sector coupling introduces new considerations, increasing the need for these charges to accurately reflect network constraints. Constraints at both the transmission and distribution

level are likely to occur with greater frequency or at different times of the day and year, as the power system changes with sector coupling. Rising demand also means grid reinforcement will likely be needed (and need to be paid for). For these reasons, the design of network charges can be another regulatory tool for supporting successful sector coupling.

Network charges can encourage demand-side flexibility and are already widely used to manage peak demand. With sector coupling, grid operators and regulators are likely to retain variable network charges because of the substantial need for demand-side flexibility and constraint management, and to minimize the grid investment required due to sector coupling. Network charges will therefore need to work with dynamic energy pricing to shift demand to times that minimize system costs and network constraints.

Regulators could consider introducing more granularity into network charges, to better reflect the times of day and year when network constraints occur – as well as the locations in which they occur. These changes might also support system-level flexibility, as it is likely that local network constraints and system-level constraints occur at similar times. However, this is not a given – and better TSO-DSO cooperation will be needed to ensure that these differences are managed.

Our pathway also envisages an increase in behind-the-meter assets such as rooftop PV. Owners of such systems often pay less in network charges because they consume less electricity from the grid, even though they still benefit from the infrastructure for the hours when they are not self-generating. This results in lower revenues for grid operators, which increases the incentive to implement flat network charges only, meaning all end-users pay the same rate for grid access depending on their connection size and regardless of consumption. Alternatively, the fixed proportion of network charges could be increased. In the U.K., residual network charges are being revised to ensure that those with behind-the-meter assets still contribute to grid costs (Figure 55). On the downside, the government has yet to announce measures to replace the lost revenue for behind-the-meter flexibility assets, creating more uncertainty and weakening investment signals.

Overall, regulators need to ensure that the structure of network charges complement the market signals they wish to send via dynamic energy pricing. In principle, all consumers should have some exposure to variable network fees and variable energy charges. In a market with a substantial share of behind-the-meter generation assets, the fixed component of network charges could be larger for residential consumers (as these tend to have relatively low electricity demand). The variable component could then be bigger for large energy users as the charges would then help grid operators to incentivize flexibility in these loads.

Allocation of wholesale price risk and granularity of price signal

Different dynamic tariffs expose customers to different levels of wholesale power price risk. This is an important issue with sector coupling because wholesale prices are expected to become more volatile as more variable generation comes online. To give two examples: the variable energy component can be structured as a dynamic real-time tariff or a static block time-of-use tariff (Figure 56). These two options create two very different price profiles and risk profiles for the end user.

There is little consensus on the optimal granularity of price signals to instigate a demand response by the end user. Therefore, regulators should aim to ensure that innovation, monitoring and evaluation of flexible tariff design enables retailers to react to the changing needs of the power sector. Retailers should also be able to adapt pricing granularly to balance between the allocation of risk and incentivizing flexible end-use.

When considering how much wholesale risk to pass on to consumers, regulators must segment the customer base and pay particular attention to vulnerable users. A price cap could be implemented for vulnerable consumers, particularly to buffer against seasonal swings in electricity prices. In some markets, retailers introduce price caps to attract customers. Octopus Energy, for instance, launched a dynamic real-time tariff in 2019 for residential customers with a smart meter. This has a cap to limit exposure to price spikes (Figure 57).
However, regulators and policy makers will likely need to avoid dampening important signals to deal with the long-term flexibility gap. Seasonal power price variability is expected to become a more prominent feature of a future power system with sector coupling, and so some level of price exposure to this seasonal volatility may be necessary to incentivize the rollout of indirect electrification. For instance, buildings might opt for a hybrid electric and hydrogen heating system in the Northern European archetype, to optimize the balance between direct and indirect electrification of this sector.

Technological readiness
The availability and cost-competitiveness of appliances to deliver demand-side flexibility is also crucial to sector coupling. Such appliances include dynamic EV chargers, 'smart' heating systems, and smart meters or hubs that are able to operate together and flexibly with the power system. EV chargers and electric heating appliances demand special attention as they will create significant flexible demand if addressed properly.
The rollout of smart meters is already underway in most places. They will be crucial to unlocking flexible demand with sector coupling, as they provide the billing infrastructure needed for dynamic tariffs. In markets where smart meter penetration is still low (such as the U.K. and Germany), this will be a barrier to successful, flexible sector coupling.
In addition, priority should be given to the standardization of smart systems, particularly for highly distributed but large loads like EV chargers and electric heating appliances. These devices will need to be connected and digitalized, to be able to respond to price signals (and potentially other external signals too) in future. Given that the rollout of these appliances is already underway, policy makers should ensure that all new appliances are 'smart' and connected so that they can respond to market signals sure and avoid being stranded.

Market access
Barriers to entry
Ensuring there are adequate flexible resources in place will not only be about implementing sufficient incentives – they also need a level playing field to compete. With that in mind, flexible technologies such as demand response and storage should be able to participate in the wholesale energy and ancillary service markets as well as any capacity mechanisms. Such an increase in potential revenue streams would better shield flexibility providers from policy and regulatory uncertainty.
Policy makers should also address other barriers that impede flexible resources' participation in such markets in practice. These include the following:

• Germany: limits on aggregation as well as stipulations on grid connection locations

• The U.K.: shorter contract lengths for some technologies (e.g., demand response)
• The Netherlands: ban on independent aggregation, meaning suppliers control the access of flexible resources to the market.

In general, performance requirements, 'shapes' of products and timing and frequency of bidding should be adjusted to create a level playing field for new flexibility sources.
These barriers may have arisen because the arrangements were set before the commercialization of newer flexible technologies such as batteries. Because the system seems to be working relatively well at present, there may be some resistance to changing arrangements, in particular from more traditional market players such as thermal generators.
The U.S. has made notable progress in this area for energy storage with the Federal Energy Regulatory Commission's (FERC) Order 841. This came into effect in May 2018 and covers six power markets. It required wholesale market rules to be changed to allow storage to take part in all services and the technology's physical and technical characteristics to be considered in market operations. The deadline to implement such changes is February 2020. This replicable framework entails reviewing the current framework for energy storage to participate in the wholesale market and understanding the barriers. Then the approach is to implement changes where necessary, specifically considering the particularities of energy storage.

Valuing new technologies

As well as enabling participation in all power markets, policy makers can introduce reforms to value more accurately the advantages of technologies like energy storage. Shorter dispatch intervals and settlement periods in the wholesale market would be one example (Section 14.2), while another would be ancillary service products that offer higher prices for a faster response: batteries can ramp up within milliseconds, compared with a few seconds for pumped-hydro plants, 10-20 minutes for aero-derivative open-cycle gas turbines (OCGTs) and 15-30 minutes for heavy-frame OCGTs. National Grid in Great Britain, for example, is introducing faster frequency response services to replace the current firm products that were designed for conventional large power plants, and the 'enhanced frequency response' product to trial batteries (Figure 58). 'Dynamic' frequency response means that the scale of the response is proportional to the scale of the frequency deviation. The new products will suit technologies like battery storage and demand response, although these markets will likely remain relatively modest in size at least for the foreseeable future. As a comparison, in Germany, the response time for frequency response reserves varies from 30 seconds to 15 minutes.
Other reforms to the ancillary markets could strengthen the pricing signals for flexibility – for example, the frequency of ancillary service procurement could be increased. At present, ancillary services in many European countries, including the U.K. and Germany, are procured through tenders, mandatory agreements and bilateral contracts up to a year ahead of time. However, if procurement was undertaken more frequently, this should help participants to adjust the market segments they serve (eg, energy, capacity and ancillary services), as conditions vary – including changes in resources or demand. If the procurement occurred more frequently, prices could then be set for each period. This would enable investors to make more efficient decisions about how to allocate generation and storage capacity between market segments, and how to provide demand response. Better pricing information could then be used to improve penalties for non-delivery of ancillary services.

As explained in Section 6, the de-rating factors27 allocated to renewables technologies will be crucial in determining the extent of their participation and their competitiveness. In 2017, the U.K. government issued new de-rating guidelines for batteries in the capacity market, reducing the factors for systems of all duration. This change effectively reduced the revenue of a one-hour storage system by 64%, for example, and as a result, less than 10% of the rated battery capacity cleared at the next auction.
(https://data.bloomberglp.com/professional/sites/24/BNEF-Sector-Coupling-Report-Feb-2020.pdf)

Current legal situation in India

Clarify the current legal status for the implementation of different time-based tariffs in the electricity sector in India. Therefore, especially pay attention to the recommendations by CEA, CERC and SERCs as well as other jurisdictional background regulations.

E.g. Section 62(3) of the Electricity Act, which guides the SERCs to incorporate TOD tariffs, says: *"The Appropriate Commission shall not, while determining the tariff under this Act, show undue preference to any consumer of electricity but may differentiate according to the consumer's load factor, power factor, voltage, total consumption of electricity during any specified period or the time at which the supply is required or the geographical position of any area, the nature of supply and the purpose for which the supply is required."*

Global best practices of Implementation of Real Time Pricing

To evaluate the potential of dynamic tariffs for India, the examples of global best practices of the implementation of dynamic tariffs as well as requirements for implementation have to be demonstrated. Divided into different industry sectors, several global best practices of the implementation of Real Time Pricing shall be shown in this chapter.

Please **determine specific global best practices** of the implementation of RTP tariffs for adapted renewable energy consumption. The tariffs should flexibly adopt the current demand and/or supply and therefore create new prices on an hourly and/or even 15-minute based calculation. Explain why the measures were successful.

- Compare different RTP programs (e.g. see Wang and Li, 2015)
- Compare different business models (e.g. see Behrangrad, 2015)

Often time-based pricing tariffs are most likely to gain popularity among industrial consumers, if they have a large ratio of on- and off-peak prices with relatively short on-peak periods. (see Wang and Li, 2015, p. 101)

Subdivided in the three categories:

1. Industry sector
2. Commercial sector
3. Residential Sector

- **Industry sector**

Please **determine at least five specific best practice** cases of the implementation of RTP tariffs in the industry sector worldwide. Show the advantages and disadvantages of the specific RTP tariffs, **determine the exact sub-industries** which participated in it, the **saved amounts** of MW per year (also as a percentage of the totally used %). Furthermore, **illustrate similarities and differences** of the respective market with the Indian market.

Please create a table with the following categories:

Country	Discom	Name of tariff and date of implementation	Characteristics of specific dynamic RTP	Participating industries	Lowering of peak demand

4.2 Commercial Sector

Please **determine at least two specific best practice** cases of the implementation of RTP tariffs in the commercial sector worldwide. Show the advantages and disadvantages of the specific RTP tariffs, **determine the exact sub-industries** which participated in it, the **saved amounts** of MW per year (also as a percentage of the totally used %). Furthermore, **illustrate similarities and differences** of the respective market with the Indian market.

Please create a table with the following categories:

Country	Discom	Name of tariff and date of implementation	Characteristics of specific dynamic RTP	Participating industries	Lowering of peak demand

- **Special Role of Demand Response Providers**

What is a Demand Response Provider? In which industries do they mostly operate?

Please list different demand response providers worldwide and show their special capabilities:

Implementation status of TOD/TOU tariffs in India

In this chapter the current status of static tariffs with diverse price settings such as Time of Day (TOD) or Time of Use (TOU) respectively has to be analyzed in order to identify industries which can adopt their energy demand to different fluctuating energy prices.

Since when have TOUs been implemented in India? Which states and Discoms were the first to introduce time-based tariffs?

Please set up lists with existing static TOD or TOU tariffs in India, their outcomes, participating industries and possible improvements (e.g. see Banerjee, Doolla and Gingh (2016), see Chunekar, Kelkar and Dixit (2014), see Kumar, Sodha and Wadhwa (2013), see PWC study)

Often the industries, who do not run 24h a day, benefit the most from TOUs (see Wang and Li, 2015, p. 101). Anyhow, it is most important to spread information about the TOU well.

Subdivided in the three categories:

1. Industry sector
2. Commercial sector

6.1 Industry sector

- Are there any static TOD/TOU tariffs existing in the Nonenergy-intensive manufacturing sector? If yes, what are their characteristics?

Please set up a table with several tariffs, which have been introduced in this specific sector, dealing with the following characteristics:

Indian State	Discom	Name of tariff and date of implementation	Characteristics of specific dynamic TOD/TOU	Participating industries	Lowering of peak demand

6.2 Commercial Sector

- Please visualize energy use by sub-sector
- Please visualize for each sub-sector load curve for winter and summer season
- Are there any static TOD/TOU tariffs existing in the commercial sector? If yes, what are their characteristics?

Please set up a table with several tariffs, which have been introduced in this specific sector, dealing with the following characteristics:

Indian State	Discom	Name of tariff and date of implementation	Characteristics of specific dynamic TOD/TOU	Participating industries	Lowering of peak demand

6.4 Way forward for Implementation of TOD

List planned implementation of TOD by States for specific industries in India. Where are potential fields of improvement? Which steps would have to be undertaken in order to further flexibilize demand and enable it for RTP?

Cost for flexibility in Industry

What would be the estimated cost for an increase/decrease of demand by e.g. 30% of a specific industry? How fast can specific industries ramp down their energy demand by e.g. 10 %, 20%, 40% or 60%?

Give estimates of the total demand capacity, which industry/-technology can ramp up or down for a specific cost per kWh (Merit-Order-Curves showing potential ramping downs for a specific energy price).

The main focus should lie on the industrial sector – commercial sector might be mentioned, but may not be the main focus

Industries of special interest are aluminum, steel, cement and chemistry sector. In the commercial sector water utilities may be analysed.

Technologies to be considered to for demand shift shall be pumps/motors, compressors, fast blowers, chillers, electric melting, chemistry sector (Chlor-Alkali), electric furnaces, heating/cooling…

Discom has to decide whether to increase the supply by purchasing additional supply to meet the current demand or to ask industry to temporarily decrease its demand (Ramp down).

Determine numbers of how many GW could be shifted by a specific industry, how fast they can ramp up / ramp down their production and how much this ramping down costs for a specific time (rough estimations – is it MW numbers, small GW numbers or high GW numbers?)

- Determine how high incentives for industrial firms would have to be to ramp down their electricity demand for a specific time period. In other words – How has does the compensation for the curtailment of production has to be?
- How high do the incentives have to be in the secondary and tertiary electricity market?

The key results of the study should be merit-order-curves for lowering contracted power supply from Discoms by

- Industry sectors
- Technologies
- Major states

For primary, secondary, and tertiary power market pan-India.

Evaluation of the applicability of RTP tariff for potential consumers

The situation and potential of dynamic pricing tariffs such as Real Time Pricing (RTP) in India should be analyzed in this chapter.

In the present Indian energy market around 3% of electricity is being traded by at an energy stock exchange. This is a strong indicator that the existing market for short term demand and supply is limited at present. It would be the role of the Indian regulator to analyze the benefits of a larger free market for electricity.

Please provide a list of Industries who could adopt their demand to dynamic real time prices. This means that they could flexibilise their demand in short-term to react on real time price changes of electricity.

Are there any RTP tariffs in India so far?

- Overview of RTP tariff implementation in India by states
- Current challenges in the implementation of RTP tariff in India

Indian State	Discom	Name of tariff and date of implementation	Characteristics of specific dynamic TOD/TOU	Participating industries	Lowering of peak demand

Check whether RTP tariffs would be applicable to different industries. Could industries using TOD/TOU tariffs (see chapter 5) also use RTPs? Are RTPs applicable for industries in India, which use RTPs in other countries (see chapter 3)?

Subdivided in the three categories:

Industry sector

Does the electricity consumption vary throughout the production process in a specific industry?

- Please visualize energy use by sub-sector (peak demand, low demand, fluctuations throughout the production process)
  Load characteristics of industrial consumers vs. renewable energy generation: Please visualize comparative analysis of wind and solar energy generation and load curve for each sub-sector for winter and summer season
- Does the respective industry already use TOD/TOU tariffs?
- Could a demand market participation (DMP) program be introduced, based on IEX spot market prices or similar?

Energy-intensive manufacturing with good RTP applicability:

By type of consumper

- Aluminum (see Arnold and Janssen, 2018) (see also as a real example from the German aluminum industry https://wupperinst.org/en/p/wi/p/s/pd/711/)
- Chlorine (see Arnold and Janssen, 2018)
- Cement (see Arnold and Janssen, 2018)
- Steel (see Arnold and Janssen, 2018)
- Paper (see Arnold and Janssen, 2018)
- Large cold storage facilities
- Metal industry in general
- E-Mobility (see Ghatikar, Parchureand Pillai, 2017)
- Zinc
- Dairy

- Food processing
- Glass industry
- Ceramic industry
- Brewery

By technology

- Industries with large heat pumps
- Industries with electrical steam generators
- Industries with flexible captive power generation capacity (negative demand from the grid, also called positive power control)
- Industries with large back-up power devices (negative demand from the grid, also called positive power control)
- Industries with combined heat and power (CHP) cogeneration (Glass production, Aluminum, …)
- Compressors
- Pumps / motors
- Fast blowers
- Chillers
- Electric melting
- Chemistry (Chlor-Alkali)
- Electrical Furnisses
- Heating / Cooling
- Spinning mill

Determine, how long firms can lower the electricity, without dismantling the production process.

Determine how fast firms in a specific industry can ramp down / ramp up their production and identify the additional cost for production delay of the respective firms.

Set up Merit-Order curves for demand response in different industrial sectors. Starting with the sector in which the opportunity cost for load shifting/load shedding

For other industries, which generate electricity from captive plants, a new model shall be proposed. This model shall aim to not only shift the peak load, but also replace captive coal-fired power plants by off-peak pricing to improve the renewable energy consumption. The main idea of the model is to make the off-peak price not higher than marginal cost of power from captive coal-fired power plants on the demand side and to purchase low price renewable energy through a marketing approach on the supply side.

Commercial Sector

Does the electricity consumption vary throughout the day in a specific commercial sector?

- Please visualize energy use by sub-sector (peak demand, low demand, fluctuations throughout the production process)
  - Large electricity consumers
  - Very large building complexes with air conditioning (e.g. Airport Hamburg using electricity at night for charging ice and storages in combination with heat pump)
  - Large cold storage facilities

  - Large commercial kitchens with
    a) ability to switch between cooking with gas or electricity
    b) ability to shift cooking of less or more electricity intensive meals (frying or not frying)
- Load characteristics of commercial consumers vs. renewable energy generation: Please visualize comparative analysis of wind and solar energy generation and load curve for each sub-sector
- Does the respective industry already use TOD/TOU tariffs?
- Could a demand market participation (DMP) program be introduced, based on IEX spot market prices or similar?
- At the moment the residential sector should not be the highest priority for governmental Demand Side Management, as high transaction costs and high hardware costs would be needed to achieve a big effect on the grid stability and flattening out the peak energy demand. Nevertheless, smart meters have many other positive side effects and therefore should be promoted continuously, especially in the long-term.

Identification of challenges in implementation of RTP tariff for identified consumers

The aim of this chapter is to identify challenges for the implementation of RTP tariffs in India for the identified potential consumers. Regulatory, technical and other issues shall be considered.

Identify barriers which have to be removed for exploitation of RTP potential and explain why these are of concern:

- Quality /reliability and costs of power purchased from DISCOMs (for large energy-intensive industries)
- Grid stability
- Legal issues
- Institutional changes
- Role of DISCOMs, SERCs, SDAs
- Investments for implementation
- Consumers inability to shift loads
- Lack of creating awareness among consumers about the efficient use of energy
- Large industries are utilizing and establishing captive power plants
- Oversupply in the power market, as it is still difficult to store large quantity of power with the existing technology
- Flexible Fossil-Fuelled Generators to accommodate changes in variable generation
- Demand-side flexibility

Demand Response Providers can support firms to adapt their behaviour to dynamic pricing mechanisms. Please determine market conditions which have favored the establishment of Demand Response Providers (Manage the flexible industries energy) worldwide.

Even if consumers in theory would be applicable to RTP tariffs, it is often not usable for energy-intensive consumers, who have own captive power plants and/or avail power supply from other sources. Nowadays, a number of industries are increasingly relying on their own generation (captive and cogeneration) rather than on grid supply, primarily for the following reasons:

- Non-availability of adequate grid supply
- Poor quality and reliability of grid supply

- High tariffs as a result of heavy cross-subsidization

Captive power plants owned by the industry are primarily used for self-consumption. There is a significant variation in captive capacity utilization within industries. Please determine reliable information on the amount and share of the industry companies with own electricity generation facilities.

If the captive power plants of industries have any surplus of power, they should be allowed to sell this to the Grid on a remunerative tariff. Under an RTP tariff this could also incentivize them to shift some energy demand in off-peak, resulting in lower pricing times and sell saved energy during peak times to the market for a high price.

Determine whether such practices are common in India or otherwise which regulations favour this behaviour.

Conclusion and future recommendations

Future recommendations shall be identified. What measures should be undertaken by the government and other stakeholders in order to facilitate the implementation in RTP tariffs in India?

- Which industries consumers could be targeted with RTP?
- What is the potential of RTP in India?
- Suggestions on the implementation of RTPs in India
  Prospects and risks of RTPs in India
- What are the regulatory or legal preconditions for a functioning RTP?
- Give recommendations for implementation of RTP tariff in India

Future recommendations for the implementation of an RTP tariff are e.g.:

- Storage System
- Flexibilization of supply (infrastructure must be improved as well as facilities to increase electricity supply in the short run by e.g. combined cycle gas turbines (CCGT))
- Load management/flexibilization of demand
- Institutional changes
  → Smart grid

At the moment the residential sector should not be the highest priority for governmental Demand Side Management, as high transaction costs and high hardware costs would be needed to achieve a big effect on the grid stability and flattening out the peak energy demand. Nevertheless, smart meters have many other positive side effects and therefore should be promoted continuously, especially in the long-term.

→ For significant Demand Side Management solutions, a market for flexibility has to be established, where different cost-efficient solutions are able to compete against each other in response to dynamic price signals.

2. Tasks to be performed by the contractor

The contractor is responsible for providing the following services:

- Specifying the current status of static Time of Day (TOD) or Time of Use (TOU) tariff implementation in India with best practice examples
- Specifying the current status of Real Time Pricing (RTP) implementation in India and showing Best Practice examples worldwide
- Evaluation of potential consumers with focus on industry with the technical ability to adapt their energy demand at short notice (1 day, 6 hours, 15 min. ahead) for an hour, half an hour, a 15 min. time span
- Show estimates for total demand capacity (in GW) for each non-captive industry and large commercial consumers able to ramp up and down and at which cost per kWh
- Applicability of a Real Time Pricing (RTP) tariff for non-captive industrial and large commercial consumers identified (Specific technical, economical and operational challenges as well as legal constraints)

Certain milestones, as laid out in the table below, are to be achieved by certain dates during the contract term, and at particular locations:

Milestone	Deadline/place/person responsible
List of states/Discoms with TOD or even TOU tariff for commercial and industry	2 weeks after start of contract
Typical load curves of large power consumers in industry, commercial and agriculture with indication on if sector operates mainly captive or grid connected.	6 weeks after start of contract
Draft Report with segmentation customers able to reduce demand, total demand reduction potential, and at which premium / compensation price (merit order curves).	10 weeks after start of contract
Final Report	12 weeks after start of contract

All deliverables and single work steps are subject to approval by GIZ and have the content to be revised as per GIZ directions until final approval is given.

Period of assignment: From 01.06.2021 until 30.11.2021.

3. Concept

In the bid, the bidder is required to show how the objectives defined in Chapter 2 are to be achieved, if applicable under consideration of further specific method-related requirements (technical-methodological concept; 1.1). In addition, the bidder must describe the project management system (1.6) for service provision.

Technical-methodological concept

Strategy: The bidder is required to consider the tasks to be performed with reference to the objectives of the services put out to tender (see Chapter 1). Following this, the bidder presents and justifies the strategy with which it intends to provide the services for which it is responsible (see Chapter 2).

Project management of the contractor

The bidder is required to explain its approach for coordination with the GIZ project.

- The contractor is responsible for selecting, preparing, training and steering the experts (international and national, short and long term) assigned to perform the advisory tasks.
- The contractor makes available equipment and supplies (consumables) and assumes the associated operating and administrative costs.
- The contractor manages costs and expenditures, accounting processes and invoicing in line with the requirements of GIZ.
- The contractor reports regularly to GIZ in accordance with the AVB of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH from 2018
- Ensure full data protection for all processes and procedures before, during and after data collection according to Indian legislation and the EU GDPR.

The bidder is required to draw up a **personnel assignment plan** with explanatory notes that lists all the experts proposed in the bid; the plan includes information on assignment dates (duration and expert days) and locations of the individual members of the team complete with the allocation of work steps as set out in the schedule.

4. Personnel concept

The bidder is required to provide personnel who are suited to filling the positions described, on the basis of their CVs (see Chapter 7), the range of tasks involved and the required qualifications.

Team leader

<u>Tasks of the team leader</u>

- Overall responsibility for the advisory packages of the contractor (quality and deadlines)
- Coordinating and ensuring communication with GIZ, partners and others involved in the project
- Personnel management, in particular identifying the need for short-term assignments within the available budget, as well as planning and steering assignments and supporting local and international short-term experts
- Regular reporting in accordance with deadlines

<u>Qualifications of the team leader</u>

- Education/training (2.1.1): University qualification (German ‘Diplom’/Master) in Electricity Markets

- Language (2.1.2): Good business language skills in English
- General professional experience (2.1.3): 20 years of professional experience in industrial consultancy, market research, statistical analysis and techno-economic feasibility analysis.
- Specific professional experience (2.1.4): at least 5 years of experience in Indian Power Market
- Leadership/management experience (2.1.5): 5 years of management/leadership experience as project team leader or manager in a company
- Regional experience (2.1.6): 5 years of experience in projects in India

Expert 1

<u>Qualifications of expert 1</u>

- Education/training (2.2.1): University Qualification (Master) in Electricity Markets
- Language (2.2.2): Good business language skills in English
- General professional experience (2.2.3): 15 years of professional experience in industrial consultancy, market research, statistical analysis and techno-economic feasibility analysis.
- Specific professional experience (2.2.4): at least 5 years of experience in Indian Power Market

Expert 2

<u>Qualifications of expert 1</u>

- Education/training (2.2.1): University Qualification (Bachelor) in Electricity Markets
- Language (2.2.2): Good business language skills in English
- General professional experience (2.2.3): 10 years of professional experience in industrial consultancy, market research, statistical analysis and techno-economic feasibility analysis.
- Specific professional experience (2.2.4): at least 5 years of experience in Indian Power Market.

5. Costing Requirement

Bidder must quote for 120 person days

6. **Eligibility Criteria for a consulting firm** (please see the document “grid for assessing the eligibility of consulting firm” for details regarding the weightage of each point.

The agency must have the following administrative and financial requirements for conducting the assignment

- Be a registered as national organization or entity
- In depth expertise of the topic with access to specific data
- References in writing scientific reports and market studies are required
- Average annual turnover for the last three financial years should be at least 80,000 Euros
- The agency should have minimum 06 employees as of 31.12.2020
- The agency must have handled at least 4 reference projects with focus on areas of project management & consulting, market research, techno-economic feasibility, statistical analysis and project planning with at least 2 project in in the last three years with minimum commission value of Euro 10,000.

- The organization must be experienced in the areas of project management & consulting for more than 15 years.
- The agency must have regional experience in India.

Other specific requirements

1. The proposed consultants need to be available from the first day of the official start of the project till the end of the project.
2. The experts assigned to the project will be agreed contractually. It has to be confirmed that only these experts will work on the report. Any deputation can only be agreed for relevant cause such as sick leave or expert leaving the company but has to be communicated and aligned with the GIZ coordinating team well in advance.
3. All communication with media (TV, radio, print and other media) has to be approved by the responsible person of GIZ.
4. All reports, slides, presentations and other media and information material need to be submitted to GIZ in soft copy and in hard copy as required.
5. All work results, including reports have to be in format, design and layout as specified by GIZ and have to follow GIZ design guidelines.
6. All calculation, graphs, figures and tables shall be made in GWh/TWh.
7. All data sources need to be scientifically reported; all data estimates need to be derived.

GIZ reserves the right to invite bidders to make a presentation about their understanding of the scope, their approach, methodology, time planning etc. GIZ shall not be liable towards meeting any expense incurred in doing so. GIZ reserves the right to disqualify any bidder in case found inconsistent with the requirements

7. Requirements on the format of the bid

The structure of the bid must correspond to the structure of the ToRs. In particular, the detailed structure of the concept (Chapter 3) is to be organised in accordance with the positively weighted criteria in the assessment grid (not with zero). It must be legible (font size 11 or larger) and clearly formulated. The bid must be drawn up in English.

The complete bid shall not exceed 30 pages (excluding CVs and company documents).

The CVs of the personnel shall not exceed 4 pages. The CVs must clearly show the position and job the proposed person held in the reference project and for how long. The CVs must also be submitted in English.

If one of the maximum page lengths is exceeded, the content appearing after the cut-off point will not be included in the assessment.

Please calculate your price bid based exactly on the aforementioned costing requirements. In the contract the contractor has no claim to fully exhaust the days/travel/workshops/ budgets. The number of days/travel/workshops and the budget amount shall be agreed in the contract as ‘up to’ amounts. The specifications for pricing are defined in the price schedule.

8. Annexes

References

Comprehensive list of references regarding to the primary (and secondary) used literature is required.
Please use Harvard quotation. Regarding to Referencing-Harvard System available under: https://www.tcd.ie/creative-arts/assets/pdf/Referencing%20-%20The%20Harvard%20System.pdf

Mandatory literature to be used:

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Payment Plan

Sl.Nr.	***Payment Plan***	***Deliverable stage***	***Timeline***
1	100%	Final Report	12 weeks after start of contract

*Service tax/GST will be paid additionally with every payment as applicable at the time of payment.

- Note: All travel expenses and related expenses incurred towards accomplishment of above deliverables would be borne by the selected organization.